

Upper Ordovician Gastropods from the Gordon Group, Western Tasmania

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Twenty-six species of gastropods are described from the Ordovician Gordon Limestone Group, in western Tasmania. Twenty-two are described from the Zeehan area and nine of these are new species and include *Raphistoma montanum*, *Liospira regina*, *Paraliospira insula*, *Lophospira corona*, *L. florencsis*, *L. argenta*, *Donaldiella brittania*, *Bracliytomaria victoria*, *Threavia maxima*. As well, a number of gastropods are recorded from other occurrences of limestones in western Tasmania including those at Queenstown, Bubs Hill and the Huskisson River from which the new species *Tropidodiscus huskissoni* is described.

INTRODUCTION

The first record of Early Palaeozoic gastropods from western Tasmania appears to be that of Gould who in 1862 reported *Raphistoma*, *Enomphalus* (two species) and *Murchisonia* (three species) in Early Silurian (= Ordovician) limestones collected from along the Gordon River. Soon after, in 1868, Bigsby listed a further 14 gastropods that had been recorded by JW Salter from western Tasmania, namely *Bellerophon pugnax*, *Eniema aemula*, *Helicotoma milligani*, *H. pusilla*, *Holopea mmmia*, *Hormotoma nerinea*, *H. usitata*, *Murchisonia franklini*, *M. mimetica*, *Pleurotomaria insueta*, *P. mimetica*, *Raphistoma aeterna*, *Scalites australis* and *Trochonema bigsbyana*. This material had been collected by Milligan in 1847 and sent to Britain where it was seen by Salter and PM Duncan (Banks and Burrett, 1980). This list was repeated by Etheridge in 1878 and by Johnston in 1885 and 1888, with some slight variations. Johnston in his later work also illustrated an additional eight Lower Silurian gastropods from the Gordon Limestones, namely *Loxonema* sp. indet., *Murchisonia* sp. indet., *Straparollus (Machrea) tasmanicus*, *Scalites salteri*, *Scalites gouldi*, *Bellerophon* sp. indet., *Trochonema etheridgei*, *Straparollus* sp. indet. None of these gastropods were described nor were the localities from which they were collected detailed.

It was not until 1896 that the first descriptions of Ordovician gastropods from western Tasmania were published. In that year, Etheridge described *Eniema montgomerii* from the Despatch Limestone, Zeehan and *Lophospira?* sp. indet., *Murchisonia* sp. indet., and *Raphistoma* sp. indet. from a white quartzite at Zeehan. Subsequently in 1898, after the receipt of additional material from the Gordon Limestone on the Gordon River, he re-assigned *E. montgomerii* to the genus *Trochonema* as well as describing *Helicotoma johnstoni* and redescribing *Trochonema etheridgei* Johnston.

The Ordovician limestones of western Tasmania occur in a number of faulted blocks (Banks and Burrett, 1989). Gastropods have been recorded from a number of these blocks in the Zeehan area, the geology of which has been discussed by Blissett (1962). The earliest of these records is that of Etheridge (1896) who described *E. montgomerii* from the Despatch Limestone which was exposed about 1 km north of the Zeehan post office (Blissett, 1962).

Subsequently Twelvetrees and Ward (1910) recognised this gastropod, together with *Raphistomina* (? gen). 2 spp. nov. and *Hormotoma* sp. indet. from the limestones exposed in the Smelter's Quarry south of Zeehan. This quarry was established to serve the Tasmanian Smelter Co., the major smelter on the Zeehan field. Chapman (1919) also reported *Hormotoma*, *Raphistomina* and *Trochonema* from the Smelter's road opposite the Smelters. Later Teichert and Glenister (1953) recorded *Helicotoma*, *Holopea*, *Hormotoma*, *Lophospira*, *Raphistoma*, and other genera while Banks (1954) also recorded bellerophonitids and patelliform gastropods.

At the Oceana mine, about 4 km south of Zeehan, Hill (1955) recorded the presence of gastropods throughout a core from the mine. Although distributed widely throughout the core, two relatively rich bands, one between 130' and 170' and another between 774' and 786', were noted. Banks (1957) also recorded gastropods in the nearby Fox's Open Cut.

Further to the south at Queenstown, Bradley (1954) recorded the presence of gastropods in the Old Flux Quarry immediately to the north of the town.

About 26 km east of Queenstown at Bubs Hill, Banks (1957) observed gastropods in faulted blocks of limestone that outcrop along the Lyell Highway (Carey and Banks 1954, Banks and Burrett, 1989).

Finally, about 6 km to the north-east of Renison Bell on the Huskisson River, Brown (1986) recorded gastropods from a correlate of the Gordon Limestone Sub-Group of Middle to Late Ordovician age.

BIOSTRATIGRAPHIC RELATIONSHIPS

The oldest of the gastropod faunas is that from the Huskisson River which was collected approximately 120 metres above the base of the Gordon Limestone (Banks and Burrett, 1986). Conodonts low in the limestone sequence are considered to be suggestive of OT12 age while trilobites 160 metres higher suggest a correlation with OT15 of Banks and Burrett's 1980 biostratigraphical scheme.

The most abundant gastropod fauna is that from the Smelter's Quarry, Zeehan. Outcropping in this quarry is a limestone that has been correlated on the basis of corals and conodonts, with the gastropod-bearing limestone at the Oceana Mine. Banks and Burrett (1989) suggest a correlation with 'the Lower Limestone Member or perhaps a little higher'. Also occurring in the quarry is the younger richly fossiliferous third elastic member from which Banks and Burrett (1989) report gastropods. It is from this unit that most of the specimens that form part of this study originate. Banks and Burrett (1989) consider the total fauna assemblages suggest a correlation with OT17 or OT18 in the Upper Limestone Member.

The Bubs Hill fauna occurs in a richly fossiliferous horizon which Banks and Burrett (1989) consider based on the conodont and brachiopod assemblage largely correlates with the Lord Silstone OT15 and the lower part of the Upper Limestone Member.

The Old Flux Quarry, Queenstown, contains a diverse fauna including corals and cephalopods, which are considered to be suggestive of a correlation with the upper part of the Lower Limestone Member (Banks and Burrett, 1989).

All the gastropod faunas described here occur in either the middle or upper part of the Lower Limestone Member or the Upper Limestone Member of the Benjamin Limestone. Calver (in Banks and Burrett, 1989) considers that the top part of the Lower Limestone Member and the Upper Limestone Member were both subtidal, supporting a normal marine fauna and that they were deposited on an extensive carbonate platform.

The gastropod faunas have a stratigraphic range from above faunal assemblage OT12 to OT18 which Edgecombe, Banks and Banks (1999), suggest would extend from the uppermost Gisbornian Stage and throughout the entire Eastonian Stage or throughout the Caradoc.

FAUNAL RELATIONSHIPS

The only other significant Late Ordovician gastropod fauna described from Australia is that from the shallow water carbonates developed around the volcanic islands in the Lachlan Fold Belt of central NSW (Percival 1995, Percival in Webby et al. 2000). In all, 29 sub-generic or higher taxa were recorded from these limestones. Of these only seven are common to both central NSW and western Tasmania with its 20 sub-generic or higher gastropod taxa (see Table 1). The level of affinity between the Late Ordovician gastropod faunas of Tasmania and NSW suggests a significant sub-provincial difference. Such a difference has also been recorded for a number of other major groups including nautiloids, corals and brachiopods (Webby et al. 2000)

Percival identified a strong level of similarity between the NSW fauna and similar aged faunas from the Klamath Mountains, California, with 31 taxa (Rohr 1980) and the Seward Peninsula, Alaska, with 26 taxa (Rohr, 1988). He recorded 16 taxa in common between NSW and the Klamath Mountains and 14 in common between NSW and the Seward Peninsula. In comparison, Tasmania and the Klamath Mountains have 10 taxa in common while there are eight taxa in common between Tasmania and the Seward Peninsula.

The high level of affinity between NSW and the Klamath Mountains faunas is also approached by that existing between Tasmania and the Klamath Mountains, providing additional support for a close association between Australia and California. Of interest is the lower but comparable level of faunal affinity between Tasmania and both Alaska and NSW.

The Tasmanian fauna includes six taxa, namely ? *Bucania*, ? *Tetranota*, *Donaldiella*, *Brachytomaria*, *Threavia* and *Clisospira*, which have not been reported from either NSW or western North America (California and Alaska). All six taxa are known from locations on either the Laurentian platform or margin. In addition, all the taxa that are common between Tasmania, NSW and western North America also occur on the Laurentian platform. This would suggest a high level of affinity between the gastropods of Tasmania and Laurentia and matches that are found in certain other groups such as brachiopods, bryozoans and some corals, Webby (2000).

The Tasmanian gastropod fauna, particularly that at Zeehan, is dominated by lophospirid and liospirid pleurotomariacans and has some similarity in composition with the *Lophospira* community recognised by Rohr (1980) from the Ordovician of California and the *Sowerbyella* – *Omniella* community from the Late Ordovician of New York (Bretsky, 1969). Both of these communities occupied essentially a shallow sub-tidal environment and a similar environment in the Middle Ordovician of New York was also dominated by *Loxoplocus* (Walker, 1972). The Tasmanian gastropod fauna is also considered to have occupied a normal marine subtidal environment and is another example of this widespread Ordovician community.

LOCALITIES

The gastropods described come from six locations scattered from the Huskisson River in the north to Queenstown in the south.

Huskisson River

(CP7259.7639 1:50,000 map series Corinna)

Smelter's Quarry / Austral Valley, Zeehan

(CP6280.5850 1:100,000 map series Zeehan)

Despatch Limestone, Zeehan

(CP6170.6220 1:100,000 map series Zeehan)

Oecana Mine, Oecana Valley

(CP6235.5745 1:100,000 map series Zeehan)

Old Flux Quarry, Queenstown

(CP8040.4100 1:100,000 map series Franklin)

Bubs Hill

(CP9870.3695 1:100,000 map series Franklin)

The distribution of the gastropods is shown in Table 2.

The majority of the specimens available are from the Smelter's Quarry, Zeehan. Apart from the moderate number of specimens from Bubs Hill only a small number of specimens have been collected from all of the other localities. In general, the quality of preservation of the material from these latter localities is poor, with many from some localities, such as the Old Flux Quarry, Queenstown, being tectonically deformed. For this reason, many of the gastropods, which may be new taxa, are purposely described in only general terms.

LOCATION OF TYPES:

AM	Australian Museum
GST	Geological Survey of Tasmania
QVM	Queen Victoria Museum & Art Gallery
TM	Tasmanian Museum & Art Gallery
UTGD	University of Tasmania, Geology Department

ABBREVIATIONS:

Ht	Height
L	Length
Hap	Height of aperture
Wap	Width of aperture
Wh	Number of whorls
Wt	Width
*	Incomplete

SYSTEMATIC PALAEOLOGY

Family Tropidodiscidae Knight, 1956
Genus *Tropidodiscus* Meek & Worthen, 1866

Type Species: *Bellerophon curvilineatus* Conrad, 1842; Lower Devonian, Schoharie, New York.

Tropidodiscus huskissoni sp.nov.

Plate 1, Figs 1–2

Diagnosis: Small to medium form of genus with distinctive angular dorsal crest.

Description: Small to medium lenticular gastropod with very distinct angular dorsal keel; whorl profile moderately rounded from dorsal keel to edge of umbilicus, then rounded more strongly; umbilici moderately wide and deep; aperture poorly known, does not appear to be greatly expanded, sub-triangular in shape; narrow parietal lip quite thick with high central ridge formed by dorsal angulation of preceding whorl; outer lip without a sinus; details of slit unknown; distinct narrow selenizone, developed on a keel; strong frequent growth lines developed, extending onto sides of keel; prominent spiral threads present.

Dimensions:	L	Wt	Wh
GST 1130(a)	5.8	—	3
GST 1130(b)	2.7	1.4	2
GST 1130(c)	7.1	5.5	4

Distribution: Holotype GST 1130a and Paratypes GST 1130b,c,d,e,f,g and h, Huskisson River.

Material: Holotype, seven paratypes and two other specimens.

Discussion: This species from the Huskisson River is of interest because of the distinct angular dorsal crest that is prominently developed. This crest clearly distinguishes *T. huskissoni* from the type species *T. curvilineatus* and the form from Zeehan. This latter form has a deeper and wider U-shaped sinus than that of *T. huskissoni*.

Etymology: Named for the Huskisson River, western Tasmania.

Tropidodiscus sp.

Plate 1, Fig. 3

Description: Medium lenticular gastropod with distinct angular dorsal crest; whorl profile gently rounded from the dorsal crest to edge of umbilici, then rounds very strongly; umbilici moderately wide and deep; aperture poorly known, does not appear to be greatly expanded, sub-triangular in shape; parietal lip quite thick with high central ridge formed by dorsal angulation of preceding whorl; outer lip with deep v-shaped sinus culminating at

dorsal angulation; details of slit and selenizone unknown; growth lines tend to be fine and closely spaced.

Dimensions:	L	Wt	Wh
UTGD 81789	16.6*	6.1	-
UTGD 82743	11.5	4.9	4

Distribution: Figured specimen; UTGD 82743 – 30m below Member C in Gordon Group, Austral Valley, below Smelter's Quarry.

Material: Figured specimen and two other specimens.

Discussion: Comparisons between the Zeehan species and *T. curvilineatus* indicate that as well as being substantially smaller, the Zeehan species also possesses a more equi-triangular aperture. The specimen illustrated by Johnston (1888 pl. v, figs 4–4a) as *Bellerophon* sp. indet. is of lenticular shape and resembles in the most general of ways *Tropidodiscus*. However, the total lack of detailed information prevents further comparison with the material from Zeehan.

Family Bucaniidae Ulrich & Scofield, 1897
 Subfamily Bucaniinae Ulrich & Scofield, 1897
 Genus *Bucania* Hall, 1847

Type Species: *Bellerophon sulcatinus* Emmons, 1842; Middle Ordovician, Chazy, New York.

? *Bucania* sp.
 Plate I, Fig. 4

Description: Medium, widely umbilicate planispiral gastropod with broad involute whorls; very gently arched dorsal surface; whorl profile quite angular at junction of dorsal surface and sides; junction marked by development of a distinct keel; curved sides turn into broad deep umbilici; sutures distinct incised; aperture sub-triangular; margin of aperture not flared; parietal inductura unknown; outer lip with wide deep v-shaped sinus culminating in a narrow flat selenizone that is bordered by narrow ridges; sculpture consists of finely developed transverse collabral lines which continue into the umbilici.

Dimensions:	L	Wt	Hap	Wap	Wh
UTGD 85485	27*	18*	-	-	5

Distribution: Smelter's Quarry, Zeehan.

Material: Figured specimen and one other specimen.

Discussion: In general appearance the Zeehan form more closely resembles *Bucania* than any of the other genera assigned to the subfamily Bucaniinae. However, it can be distinguished from *B. sulcatina* by the more angular junction of the dorsal and lateral whorl surfaces, more angular sub-triangular aperture and lack of spiral sculptured elements. Although spiral sculptural elements have

been given by Knight et al. (1960) as a typical character of the genus *B. ? christiani* (Koken) from the Middle Ordovician of the Oslo region, Norway also lacks such spiral sculptural elements apart from a few traces of cords near the umbilical margin (Yochelson, 1963).

Subfamily Plectonotinae Boucot and Yochelson, 1966
 Genus *Tetranota* Ulrich & Scofield, 1987

Type Species: *Bucania bidorsata* Hall, 1847; Middle Ordovician, Watertown, New York.

? *Tetranota* sp.
 Plate I, Figs 5–6

Description: Small to medium narrowly umbilicate planispiral gastropod with broad involute whorls; well rounded dorsal surface with central raised crest between pair of strong spiral cords; aperture broadly crescentic; margin of aperture does not appear to be greatly flared; another cord located between dorsal crest and edge of umbilicus; fine closely spaced transverse growth lines.

Dimensions:	L	Wt	Wh
UTGD 89153	10.5	10	-
UTGD 81789a	16	17	-

Distribution: UTGD 89153, 81789a – Smelter's Quarry, Zeehan; UTGD 80895 – Bubs Hill, 615–640 metres above sea level.

Material: Figured specimen and two other specimens.

Discussion: Poor preservation and lack of specimens prevents a more definite identification and description.

Family Raphistomatidae Koken, 1896
 Subfamily Raphistomatinae Koken, 1896
 Genus *Raphistoma* Hall, 1847

Type Species: *Maclurea striatus* Emmons, 1842; Middle Ordovician; Chazy, New York.

Raphistoma montanum sp. nov.
 Plate I, Figs 7–10

Diagnosis: Medium-sized, high spired form of genus with an umbilicus.

Description: Medium, low spired gastropod with angular whorl profile; from abutting upper suture, profile flat to very gently concave to whorl periphery marked by selenizone; below profile strongly convexly rounded onto the small base where it rounds more strongly into the narrow umbilicus; sutures distinct; aperture sub-angular; thick columellar lip thickens towards junction with outer lip; parietal inductura present; outer lip distinctly sigmoidal on upper whorl surface; distinct v-shaped sinus that culminates at whorl periphery in a notch that generates a selenizone; below notch outer lip continues quite

strongly prosoclinally; narrow convex selenizone forms carina at whorl periphery; sculpture composed of coarse collabral lines.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 82706	6.6	10.5	-	-	-

Distribution: Holotype UTGD 82706, Paratype UTGD 81814 Smelter's Quarry, Zeehan; Old Flux Quarry, Queenstown.

Material: Type specimens and one other specimen.

Discussion: The form from Zeehan can be distinguished from *R. striatum* by the higher spire, smaller size and presence of an umbilicus.

One of the two species illustrated by Johnston (1888) as *Straparollus (Maclnrea) tasmanicus* was considered by Etheridge 1898 to be more properly assigned to the genus *Raphistoma*. Comparison between this species *R. tasmanicus* as illustrated by Johnston (1888 pl. v figs 1–1a) and the form from Zeehan in other than the most superficial fashion is not possible because of the inadequate nature of Johnston's illustrations and the lack of detailed information.

One poorly preserved specimen QVM:88:G42, possibly of this species, is known from the Old Flux Quarry, Queenstown.

Etymology: Named for the Montana Mine, Zeehan.

? *Raphistoma* sp.
Plate 1, Figs 11–13

Description: Medium, low spired, gradate gastropod with angular whorl profile; from distinct impressed sutures broad flat ramp to cord located about mid-way across the upper-outer whorl surface; below cord whorl profile gently concave to distinctive peripheral angulation; below angulation well rounded onto small narrow base before turning tightly into narrow umbilicus; aperture sub-angular; columellar lip thin, straight, gently reflexed; parietal inductura lacking; outer lip only partly known; from upper suture distinctly prosoclyrt across cord to selenizone below this it is arched forwards for a short distance before turning and continuing orthoclinally; tendency for growth rugae to develop giving whorl surface and undulatory appearance.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 80899	10.5	8*	-	-	5
UTGD 90862a	7.1	7.8	3.3	3.8	5
UTGD 90862b	8.9	11	-	-	5

Distribution: UTGD 80899 – Bubs Hill, 615–640 metres above sea level; UTGD 90862a & b – Smelter's Quarry, Zeehan.

Material: Four specimens.

Discussion: This form, although represented by only a small number of specimens, can be clearly distinguished from any other gastropods found on the West Coast and *R. striatum*. Comparison with the type species reveals the Tasmanian form as having a higher, more gradate spire, more extended base, a distinctive cord on the upper outer whorl surface and simple prosoclyrt upper outer whorl lip. Such differences also distinguish this form from *R. montanum*.

Although quite distinguishable from the existing concept of the genus *Raphistoma*, this form is a member of the Raphistomatinae with its narrow base, narrow umbilicus; more or less flattened upper whorl surface, deep v-shaped labral sinus and peripheral selenizone. Of the genera assigned to this subfamily, it most closely approaches *Raphistoma* from which it can be clearly distinguished. Thus it may well prove to be a new genus characterised in part by its higher spire and simple outer upper whorl lip, but in view of the small sample available at present it is considered more appropriate to assign it tentatively to the existing genus *Raphistoma*.

Subfamily Liospirinae Knight, 1956
Genus *Liospira* Ulrich & Scofield, 1897

Type Species: *Plenrotomaria micula* Hall, 1862; Upper Ordovician; Dunleith, Wisconsin.

Liospira regina sp. nov.
Plate 1, Figs 14–16

Diagnosis: Typical form of genus with a longer thickened and excavated columellar lip.

Description: Small to medium lenticular gastropod with convex selenizone forming whorl periphery; sutures distinct abutting; whorl profile from upper suture to whorl periphery flat to gently convex, below periphery more strongly rounded; base gently rounded; cryptomphalous; aperture elongate; columellar lip short thickened and excavated; parietal inductura unknown; outer lip passes gently prosoclyrtly backwards from upper suture to selenizone and gently prosoclyrtly forwards below the selenizone; convex selenizone moderately wide largely on upper whorl surface; sculpture composed only of fine growth lines.

Dimensions:	Ht	Wt	Hap	Wap	Wh
UTGD 90867a	9.4	16.5	5.8	-	5
UTGD 90867b	4.2*	8.5*	-	-	4

Distribution: Holotype UTGD 90867a, Paratypes UTGD 90867b & c Smelter's Quarry, Zeehan; UTGD 80885z 615–640 metres above sea level, Bubs Hill.

Material: Type specimens and 14 other specimens.

Discussion: Comparison with the type species indicates some differences with the western Tasmanian form, including the tendency to be slightly higher spired. However, it retains the distinctive lenticular shape typical of the genus and so can be readily distinguished from *Paraliospira* found at Zeehan. The columellar lip of *L. regina* appears to be longer, thicker and more deeply excavated than that of the type species. Again, useful comparisons are limited by the inadequate quality of the Tasmanian material.

Etymology: Named for the Silver Queen Mine, Zeehan.

Genus *Paraliospira* Rohr, 1980

Type Species: *Liospira? mundula* Ulrich & Scofield, 1897; Middle Ordovician, Daneville, Kentucky.

Paraliospira insula sp. nov.
Plate 1, Figs 17–19

Diagnosis: Typical form of genus with more strongly developed carina on upper outer edge of whorl.

Description: Medium, low spired gastropod with angular whorl profile; sutures distinctly abutting; flat to gently concave whorl profile from upper suture to carina on upper outer edge of whorl; below carina profile flat or very gently concave for short distance before becoming distinctly convex and rounding onto whorl base where gently convex; whorl periphery formed by carina; umbilicus absent; circum-umbilical ridge occasionally developed; aperture angular; columellar lip thick, possibly reflexed; parietal lip moderately thick; outer lip thinner; from upper suture growth lines strongly prosocyr to edge of carina; details of aperture otherwise unknown; selenizone bordered by cords on occasion; fine closely spaced growth lines and occasional growth rugae developed; sculpture absent.

Dimensions:	Ht	Wt	Hap	Wap	Wh
UTGD 24202	9.4	12.5	-	-	4
UTGD 81789m	7.2	10.1	3.9*	-	4
UTGD 82744	6.1*	10.4	3.3*	-	4*
UTGD 90867d	5.6*	10.9*	-	-	5
UTGD 80890	6.4	10.9*	-	-	5
UTGD 80885a	6.5*	10.8*	-	-	5
UTGD 80885b	4.8	7.4	-	-	5
UTGD 80885c	7.4	11.4	3.6	-	6
UTGD 80855d	6.6	8.7	3.0	-	5

Distribution: Holotype UTGD 90867d, Paratypes UTGD 81789m, UTGD 24202 Smelter's Quarry, Zeehan; Paratypes UTGD 82743 & 4, 30 metres below Member C in Gordon Group Austral Valley below the Smelter's; Paratypes UTGD 80885b and 80890, 610–615 metres above sea level, Bubs Hill.

Material: Type specimens and 25 other specimens.

Discussion: The genus *Paraliospira* was established by Rohr (1980) to contain forms that were intermediate or gradational in form between *Liospira* and *Raphistoma*. This new genus was characterised as being 'not as lenticular as *Liospira* nor does it have the extended base of *Raphistoma*'. Comparison of the Western Tasmanian material with *P. mundula* is limited because of the relatively poor preservation of the Tasmanian material. As figured by Ulrich & Scofield (1897, pl. 69, figs 37–41), the type species is slightly higher spired, has a narrow umbilicus present and has a less strongly developed carina.

Comparison with the specimens of *P. mundula* from the Klamath Mountains described and illustrated by Rohr (1980), pl. 5, figs 7–13) reveals that the latter is slightly more lenticular in shape, has a less angular whorl profile and a less strongly developed carina.

Etymology: Named for Tasmania's geographical status as an island.

Family Helicotomidae Wenz, 1938
Nov. gen. et sp.
Plate 1, Figs 22–24

Description: Medium low spired gradate gastropod; whorl profile angular; from upper suture flat to gently concave ramp horizontal to inclined downwards to outer upper angulation which carries a selenizone bordered by two strong cords; outer whorl profile almost straight before rounding onto base; whorl periphery at base of outer whorl; distinct but variable sutures; aperture sub-circular; thickened arcuate columellar lip, possibly reflexed; parietal inductura thinner; from upper suture outer lip passes prosoclinally or prosocyr to upper-outer angulation, where a sinus which generates a selenizone is developed; below selenizone, lip passes typically prosocyr to the edge of the base from where it continues backwards; umbilicus lacking; no element or spiral sculpture present apart from cords bordering the seleni

Family Uncertain

Genus *Lesnerilla* Koken, 1898

zone and a variably developed cord on the ramp immediately adjacent to the upper suture; growth lines variable ranging from fine to coarse but are typically fine and closely spaced; in later growth stages tendency for whorl to become less tightly coiled, but they do not become disjunct.

Dimensions:	Ht	Wt	Wap	Hap	Who
UTGD 93557a	9.4	17.3	-	5.5	5
UTGD 93557b	9.7	13.1	-	5.1	5
UTGD 93557c	11.4	15.5	4.8	5.4	4*
UTGD 93557d	10.0	16.2	5.0*	5.5	4*
UTGD 93557e	7.2	8.0	3.4	3.2	4

Type Locality: Gordon Limestone Station MC45 Mole Creek (co-ordinates 447003.53992.62).

Distribution: Mole Creek localities MC45, 50, 58A, 99, and 199; Smelter's Quarry, Zechan.

Material: Figured specimens and 25 other specimens.

Discussion: In general appearance this Tasmanian form more closely resembles the genera *Polthemia* and *Helicotoma* than any other members of the Helicotomidae. It can be clearly distinguished from *Polthemia* by lack of an umbilicus, the simple suture and shoulder area, the nearly horizontal ramps bordered by the outer-upper angulation or the lack of spiral sculptural elements on the base. Similarly, it can be clearly distinguished from *Helicotoma* by its distinctly higher spire, lack of an umbilicus, less strongly developed carina and differently shaped outer lips. In some of these respects namely the height of the spire, the less strongly developed carina and shape of the outer lip it resembles Koken's genus *Palaeomphalus* from the Ordovician of Estonia. However, the type species of this genus *P. gradatus* is more than twice the size of the Tasmanian form.

At present *Palaeomphalus* is poorly known and has been synonymised by Knight et al. 1960 with *Helicotoma* and little good would be achieved by re-establishing such an inadequately known genus and assigning the Tasmanian form questionably to it. Rather the Tasmanian form is considered a new genus that can be clearly distinguished from the other Ordovician members of the Helicotomidae.

Type Species: *Maclurea infundibulum* Koken 1896; Middle Ordovician; Olana, Sweden.

Lesnerilla johnstoni (Etheridge)
Plate 2, Figs 1-4

1898 *Helicotoma johnstoni* Etheridge, p. 73, pl. 15, figs 6-8, pl. 16, figs 3-4

Helicotoma johnstoni Etheridge, Fletcher, p. 88.

Description: Medium depressed spired, discoidal gastropod; whorl profile angular; from upper suture flat ramp moderately inclined upwards to an angular narrow keel which carries a narrow convex selenizone; outer whorl profile gently convex rounding more sharply into the moderately wide umbilicus; sutures deep; columellar lip moderately thickened, straight to very gently arcuate; parietal inductura thin; outer lip similar thickness to columellar lip; from upper suture the outer lip passes variably prosoclinally to the sinus on the keel; below the sinus on the outer whorl surface it arches forwards initially rapidly then more gently to about the whorl periphery where it passes backwards gently to the basal edge of the whorl from where it continues backwards across the base to the umbilicus; the degree of arching of the outer lip is quite variable both within a specimen and between specimens; no element of spiral sculpture present; collabral lines quite variable ranging from fine closely spaced lines to coarse irregularly spaced and at foliaceous lines; typically lines become coarser with growth.

Dimensions:	Ht	Wt	Hap	Wap	Wh
F.4265A	24.1	31.3	-	-	4
F.4265B	14.2	32.3	11.8	9.5	4
UTGD 59023	8.3	14.9	6.1	4.9	4
UTGD 81789b	8.7	12.0	6.6*	4.4	4

Distribution: Australian Museum Syntypes AM F.4265A and F.4265B, Gordon Limestone, Gordon River, western Tasmania; Hypotypes UTGD 59023 and 81789, Smelter's Quarry, Zechan.

Material: Syntypes, hypotypes and seven other specimens.

Discussion: The genus *Helicotoma* is characterised in part by being a low spired gradate gastropod with a nearly horizontal ramp bordered by a carina carrying a short slit that generates a selenizone. The Tasmanian species *H. johnstoni* has a depressed spire with a ramp variably but definitely inclined upwards and outwards to the carina which has a selenizone all of which are features typical of the genus *Lesnerilla*. In view of this the Tasmanian species is reassigned to this genus although it can be clearly distinguished from the type species by its trapezoidal aperture, more gently inclined ramp, shallower sutures and to-date lack of any evidence for the final

whorl becoming disjunct. In these respects *L. johnstoni* much more closely resembles *L. cf. L. marginalis* described by Rohr (1980) from the Middle Ordovician of California.

Johnston (1888) figured two quite dissimilar gastropods as *Straparollus (Maclurea) tasmanicus*. One, Plate 5 Figs 1 and 1a, is a low spired nearly lenticular form which Etheridge (1898) considered should be regarded as a species of *Raphistoma*, namely *R. tasmanicum* (Johnston). The other gastropod illustrated on Plate 5 Fig. 7 by Johnston, was assigned by Etheridge to *H. johnstoni*.

Although the Zechan specimens tend to be smaller and have a more variably inclined ramp than the syntypes, there are few differences apparent. However, the relatively poor preservation of the Zechan material prevents more detailed comparison.

Family Eotomariidae Wenz, 1938
 Subfamily Eotomariinae Wenz, 1938
 Genus *Eotomaria* Ulrich & Seofield, 1897

Type Species: *Eotomaria canalifera* Ulrich & Seofield, 1897; Middle Ordovician, Murfreesboro, Tennessee.

Eotomaria sp.
 Plate 2, Fig. 5

Description: Medium, low spired trochiform gastropod with lower border of selenizone forming periphery; sutures distinct, abutting; whorl profile angular, from upper suture profile flat to very gently convex to upper edge of selenizone; concave selenizone bordered by two distinct cords, the lower of which forms the whorl periphery; below angular periphery basal profile gently convex to possible narrow umbilicus; details of aperture poorly known; from upper suture growth line strongly prosocyrct; nature of selenizone lunule unknown; fine closely spaced collabral lines developed.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 90866a	14.7	14.3	-	-	7
UTGD 90866b	11.7	14.0	-	-	6

Distribution: UTGD 90866a & b, Smelter's Quarry, Zechan.

Material: five specimens.

Discussion: The incomplete preservation of the material from Zechan prevents useful comparison with the type species except that the former appears to be slightly higher spired. One specimen from Zechan UTGD 90866b is encrusted with bryozoa.

Family Lophospiridae Wenz, 1938
 Subfamily Lophospirinae Wenz, 1938
 Genus *Lophospira* Whitfield, 1886

Type Species: *Murchisonia bicincta* Hall, 1847; Middle Ordovician, Waterdown, New York (= *M. milleri* SA Miller, 1877 pro *M. bicincta* Hall, 1847).

Discussion: Tofel and Bretsky (1987), reviewed the taxonomy of *Lophospira* as part of a detailed study of more than 2500 lophospirid gastropods from the Middle Ordovician of the Upper Mississippi Valley in Wisconsin and Illinois. They considered that the placement by Knight et al (1960) of *Lophospira* and *Donaldiella* as subgenera of *Loxoplocus* was not warranted and rather they should be maintained as separate genera. Subsequent authors have also adopted this position, e.g. Wagner (1999).

The study of Tofel and Bretsky resulted in the definition of five species of *Lophospira* co-existing in the same three-metre interval of fine-grained heavily bioturbated carbonates. They considered that these carbonates had been deposited on a broad shallow tropical shelf whose diverse benthic marine fauna was characteristic of normal marine salinity. At Zechan in a comparable environment, three distinct, co-existing species of *Lophospira* are identified in this study.

Lophospira corona sp. nov.
 Plate 2, Figs 6-9

Diagnosis: Smaller more turbinate form of genus with two fine distinct cords bordering the selenizone.

Description: Small to medium turbinate, gradate gastropod with a well developed convex selenizone; whorl profile with three distinct angulations; middle angulation most strongly developed and forms periphery at about mid-whorl; lower angulation lies beneath lower suture; shoulder or upper angulation lies close to upper suture between upper suture and shoulder angulation whorl profile flat to gently inclined; between shoulder and middle angulation whorl profile strongly concave; below middle angulation profile gently concave; distinct impressed sutures variably located from immediately beneath whorl periphery to just above lower angulation; umbilicus typically absent; (occasionally small narrow umbilicus developed); aperture ovoidal; thick columellar gently curved and excavated; thin parietal inductura developed; outer lip thin with narrow sinus in peripheral angulation; from upper suture outer lip moderately prosocline to peripheral angulation; below angulation it is distinctly prosocyrct; prominent convex selenizone on middle peripheral angulation; bordered by two fine threads; sculpture composed of three spiral angulations; infrequently a fourth spiral cord developed on whorl base below third major angulation; collabral lines above and below selenizone variable from fine closely spaced to strong regularly and widely spaced.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 80899a	24	16.9*	10.1	-	5+
UTGD 80899b	26.7	15.2	7.4	-	6+
UTGD 80899c	18.2	14.0	7.3	6.1	5+
UTGD 90025b	25.6*	17.8	7.3	8.3	4+
UTGD 90862a	9.3*	7.3	4.2*	-	4+
UTGD 90862b	8.6	8.0	-	-	6

Distribution: Holotype UTGD 80999a, Paratypes UTGD 90025b, 90862a,b,c,d & e, Smelter's Quarry, Zeehan;

Material: Type specimens and 20 other specimens.

Discussion: This form from Zeehan is very similar to the type species *L. milleri* with the only differences being the former's generally smaller size, often shorter more turbinate appearance and the presence of two fine distinct cords bordering the selenizone. Often these cords are more strongly developed on those specimens possessing stronger and more widely spaced growth lines. Although not found on the type species similar cords bordering the selenizone occur on *L. (L.) perangulata* (Hall) described by Rohr (1980) from the Middle Ordovician or Late Ordovician of the Klamath Mountains, California. This latter species can be distinguished from the Zeehan form by its much higher spired appearance.

Etymology: Named for the crown-like appearance of this gastropod.

Lophospira florencis sp. nov.
Plate 2, Figs 10–12

Diagnosis: More fusiform member of genus with suture located immediately below periphery of preceding whorl, variable growth lines and two spiral angulations the lower of which becomes less developed with growth.

Description: Medium, turbinate to fusiform angular gastropod with convex selenizone; whorl profile with two prominent angulations; upper angulation more strongly developed forming periphery at about mid-whorl; lower angulation lies well below suture; in early whorls lower angulation quite strong but with growth becomes progressively weaker until in the later whorls of larger specimens it is absent; distinct sutures impressed; whorl profile from upper suture to selenizone variable concave; below selenizone initially concave but in later whorls almost flat to gently convex onto whorl base; umbilicus absent; columellar lip straight; parietal lip developed; from upper suture outer lip moderately prosocline culminating in a sinus that generates a selenizone; below selenizone more gently prosocline; convex selenizone with shallow, fine closely spaced lunulae bordered by two threads; suggestion that selenizone also forms a shallow channel in the outer lip; sculpture composed of spiral angulations; collabral lines change with growth, initially strong and widely spaced with growth becoming finer and more closely spaced together.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 59023a	21.8	9.6	9.3	3.8	5
UTGD 81789c	14.9	12.2	-	-	5+

Distribution: Holotype UTGD 59023a, Paratypes UTGD 81789c & d, Smelter's Quarry, Zeehan.

Material: Type specimens and seven other specimens.

Discussion: This Zeehan species can be clearly distinguished from *L. milleri* and *L. corona* by its tendency to assume a fusiform shape; possession of two spiral angulations, the lower of which becomes less developed with growth; variable growth lines; the location of the suture immediately below the periphery of the preceding whorl. In general appearance it resembles *L. sumnerensis* (Salford) from Nashville, Tennessee, as illustrated by Ulrich & Scofield (1897, pl. 73, figs 18–20). Although similar in general appearance *Loxoplocus* cf. *L. (Lophospira) sumnerensis* (Salford) described by Rohr (1980) from the Late Ordovician to Early Silurian of the Klamath Mountains, California, the latter form can be distinguished by its concave selenizone.

Etymology: Named for the Florence Mine, Zeehan.

Lophospira argenta sp. nov.
Plate 2, Figs 13–16

Diagnosis: Smaller more angular form of genus lacking shoulder and with lower suture lying immediately below the lowest spiral angulation of preceding whorl.

Description: Small to medium high spired angular gastropod with convex selenizone; whorl profile with two prominent angulations; upper angulation more strongly developed and forming periphery at about mid-whorl; lower angulation lies immediately above lower suture; a third very much weaker angulation or strong cord lies immediately above the selenizone; from the upper suture to weak angulation upper whorl surface gently convex but with a tendency to develop swellings with growth; gently concave profile between weaker angulation and selenizone; below selenizone gently concave to lower angulation; base gently rounded; sutures, sharp impressed; umbilicus absent; columellar lip nearly straight, thin and partially reflexed abapically; parietal inductura present, outer lip thin; from upper suture growth lines very gently prosocline until near weakest angulation where they become more strongly prosocline to the selenizone; where growth lines cross weakest angulation slight flexures may be developed; below selenizone lines prosocline across outer whorl surface and on the base; distinct convex selenizone on peripheral angulation; growth lines fine closely spaced; tendency for whorls to become disjunct in later growth stages.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 90862c	9.1*	7.0	3.1	3.2	3+
UTGD 81789e	9.3*	7.0	-	-	2+
UTGD 80890a	19.9	11.5	-	-	8+
UTGD 80890b	16.8	8.5*	5.0*	-	5+

Distribution: Holotype UTGD 80890a, Paratypes UTGD 80890b & c, 610–615 metres above sea level, Bubs Hill; UTGD 90862c & f and UTGD 81789e, Smelter's Quarry, Zeehan; Old Flux Quarry, Queenstown.

Material: Type specimens and 21 other specimens.

Discussion: The subgenus *L. (Loxoplocus)* is diagnosed by Knight et al. (1960) as having at least the later whorls disjunct. In fact, the type species *L. (L.) solutus* is characterised by having most whorls disjunct and being exceptionally high spired. The diagnosis of the turbinate subgenus *L. (Lophospira)* provided by Knight et al. (1960) notes that the whorls are mostly contiguous. However, a number of species assigned to *Lophospira* are disjunct in their later whorls e.g. *L. serrulata* (Salter) and *L. helicteres* (Salter) (Tofel and Bretsky 1987). Because of the general similarity of the Zeehan form with that of *L. milleri* the type species of *Lophospira* it is assigned to this genus rather than *Loxoplocus*.

Comparison of the Zeehan form with *L. milleri* reveals the former as being distinct in a number of characters. The uppermost spiral angulation of the type species is much closer to the upper suture and in fact forms a distinctive shoulder, a feature absent in the Zeehan species. The more angular appearance of the smaller Zeehan form is accentuated by the lower suture lying immediately below the lowest spiral angulation of the preceding whorl rather than at or above as does that of the type species. For similar reasons, this form can be distinguished from *L. corona* also found at Zeehan.

Poorly preserved specimens possibly attributable to this species are known from the Old Flux Quarry, Queenstown.

Etymology: Named for the Argent Mine, Zeehan.

? *Lophospira salteri* (Johnston) 1888

1888 *Scalites salteri* Johnston, pl. 5, fig. 2.

Description: Medium to large trochiform gastropod with prominent mid-whorl peripheral angulation; whorl profile with three angulations; whorl profile from upper suture to shoulder angulation flat; below shoulder to mid-whorl angulation distinctly concave; from mid-whorl angulation gently concave to third angulation; base rounded; narrow umbilicus developed; columellar lip moderately thick, arcuate; parietal lip developed; outer lip little known; col-labral lines not preserved.

Dimensions:	Ht	Wh	Hap	Wap	Wh
TM Z966	39.7	27.7	-	-	5+

Type Locality: Gordon Limestone, Tasmania.

Material: Tasmanian Museum Hypotype, TM Z966.

Discussion: The single available specimen is poorly preserved being quite coarsely crystalline and so lacking many finer details. Comparison with *Scalites angulatus* Emmons, the type species of that genus, reveals numerous gross differences. The type species has only a single spiral angulation formed at the junction of the shoulder and outer whorl surface. As a consequence while the whorl profile of the type species is gradate that of the Tasmanian specimen with its three spiral angulations is quite angular. An umbilicus present in the Tasmanian form is lacking in the type species.

It is thought that the Tasmanian specimen assigned to the genus *Scalites* by Johnston should be more properly assigned to the genus *Lophospira* because of its gross morphology. However, the poor preservation of the single available specimen and lack of locality information prevent satisfactory identification.

Genus *Donaldiella* Cossman, 1903

Type Species: *Goniospira filosa* Donald, 1902; Upper Ordovician; Shalloch Mill, Ayrshire, Scotland.

Donaldiella brittania sp. nov.

Plate 2, Figs 17–20

Diagnosis: Higher spired form with less angular whorl profile that changes with growth and a broader, deeper sinus.

Description: Medium, high spired, numerous whorled gastropod with a selenizone at the mid-whorl periphery; sutures, distinct impressed; whorl profile changes with growth; typically distinct strong cord developed immediately below suture forming very narrow shoulder; between upper cord and that bordering selenizone outer whorl surface strongly concave in smallest whorls but becoming flatter until finally gently convex in larger whorls; selenizone occupying mid-whorl peripheral keel and bordered by two cords; keel quite prominent in smaller whorls but can become much weaker in largest whorls; in smaller whorls selenizone can be strongly convex but in larger whorls much more gently convex; below selenizone to cord at edge of whorl base outer whorl surface concave to gently convex; basal margin cord variably developed; base flat to gently convex; umbilicus absent; aperture poorly known; parietal inductura developed; from upper suture growth lines strongly prosoclyt passing backwards with a moderate obliquity; below selenizone growth lines strongly prosoclyt but inclined forwards; selenizone with fine closely spaced lunules; growth lines distinct, variable, tend to be fibrous; sculpture composed

of collabral lines and cords at top and bottom of outer whorl surface; occasionally cords also developed on base and outer whorl surfaces.

Dimensions:	Ht	Wt	Wh
UTGD 81789j	26.5	-	9+
UTGD 81789k	23.6*	14.3	4+
UTGD 81789l	24.0*	20.0	2+
UTGD 24221	17.0*	14.1	3+
UTGD 24152	16.7*	7.0	6+
UTGD 59023	21.0	10.5	9+

Distribution: Holotype UTGD 24221, Paratypes UTGD 59023, 81789c, k & l, and all other material, Smelter's Quarry, Zeehan.

Material: Type specimens and 40 other specimens.

Discussion: Comparison between the Zeehan species and *D. filosa* is restricted by the poor preservation of both. In general appearance the Zeehan species can be distinguished by being higher spired, having a less angular whorl profile, broader and deeper sinus and changing whorl profile with growth.

Etymology: Named for the Britannia mine, Zeehan.

Family Trochonematidae Zittl, 1895
Genus *Trochoneua* Salter, 1859
Subgenus *Trochoneua* Salter, 1859

Type Species: *Pleurotomaria umbilicata* Hall, 1847; Middle Ordovician; Middleville, New York.

Trochoneua (Trochoneua) etheridgei Johnston, 1888

1888 *Trochoneua etheridgei* Johnston, pl. 5, figs 13–14.

1889 *Trochoneua etheridgei* Johnston, Etheridge, p. 75, pl. 16, figs 5–6

1971 *Trochoneua etheridgei* Johnston, Fletcher, p. 94.

Description: Medium turbiniform gastropod with numerous spiral angulations most prominent of which has a channel within it; profile initially angular, becoming sub-angular with growth; profile flat from upper suture to weakly developed shoulder angulation, then concave between each of other angulations; with growth areas between angulations becoming flatter; angulations variably spaced over whorl surface; peripheral angulation at about mid-whorl is most prominent angulation throughout growth; other angulations become less pronounced with growth; channelled sutures initially shallow become deeper with growth; tendency in later whorls to become disjunct; narrow umbilicus developed, aperture ovoidal; columellar lip unknown; parietal lip thick, well developed; thick broad outer lip prosocline from upper suture to peripheral angulation; becomes more strongly prosocline at each angulation, then continues prosoclinally to umbilicus; collabral lines fine and closely spaced, occasional growth rugae in later growth stages; sculpture composed of seven spiral angulations.

Dimensions:	Ht	Wh	Hap	Wap	Wh
F. 4266	15.7	16.7	6.3	-	5

Location of Types: Australian Museum Hypotype, F.4266. This specimen was purchased by the Australian Museum from the Tasmanian Museum and Art Gallery in 1896 and may, as suggested on its accompanying label, have been illustrated by Johnson in 1888. However, the poor quality of Johnson's illustration prevents definite confirmation.

Type Locality: Johnson (1888) only noted that the specimens were from the Gordon Limestones, Tasmania, but Etheridge (1898) in his redescription gives the locality as the Gordon River, West Tasmania.

Material: Hypotype.

Discussion: The numerous spiral angulations (possibly seven) of this species distinguish it immediately from *T. (T.) umbilicata*, which has only four such angulations. The subgeneric diagnosis of Knight et al. (1960) includes the presence of only four spiral angulations. Although the Tasmanian form is not consistent with this diagnosis, it is clearly a member of the genus with its angular turbiniform shape and channel in the major spiral angulation. Furthermore, apart from the numerous spiral angulations there are few differences between the Tasmanian form and the type species. Thus, it may well be that the subgeneric concept must be expanded but the lack of specimens of the Tasmanian form does not provide an adequate basis on which to do this at present.

Trochoneua (Trochoneua) montgomerii (Etheridge), 1896

Plate 2, Figs 21–23

1896 *Eunema montgomerii* Etheridge, p. 47, figs 21–22.

1898 *Trochoneua montgomerii* (Etheridge), Etheridge, p. 75.

1971 *Eunema montgomerii* Etheridge, Fletcher, p. 87.

Description: Medium turbiniform gastropod with four spiral angulations and channelled sutures; angular whorl profile; form upper suture to shoulder angulations profile flat, then concave between other angulation; angulations spaced approximately equidistantly; the second and third angulations are the most strongly developed; the second typically forms the whorl periphery and is the site of the channel and an extremely shallow sinus; sutures deep; base rounded; umbilicus may be developed but generally absent; aperture ovoidal; columellar lip of moderate thickness arcuate and reflexed; thin well developed parietal lip; outer lip straight, prosocline and with only an exceedingly shallow sinus or flexure developed on the prominent upper angulation; fine closely spaced growth lines; sculpture composed only of four spiral angulations.

Dimensions:	Ht	Wh	Hap	Wap	Wh
F.50631	16.6	11.9	-	-	5
F.50632	11.6	5.5	4.6	3.5	5
UTGD 81789a	17.8	17.9	-	-	4+

Location of Types: Australian Museum Syntypes F.50631 and F.50632. Presented to the Australian Museum by Mr A Montgomery.

Distribution: Syntypes F.50631 and F.50632, Despatch Limestone, Zeehan; Gordon River Limestone, Gordon River, West Tasmania (Etheridge, 1898); Figured Specimen UTGD 81789a, Smelter's Quarry, Zeehan; Old Flux Quarry, Queenstown.

Material: Type material, figured specimen and one other specimen.

Discussion: Comparisons between *T. (T.) montgomerii* and the type species reveals a few minor differences. The smaller Zeehan species has a more strongly reflexed columellar lip and a narrow sinus.

Currently *Enuema* is considered by Knight et al. (1960) a subgenus of *Trochonema* distinguished by being much like *Trochonema sensu-stricto* but with a higher spire. Comparison between the Zeehan material and the type species *T. (E.) strigillatunni* reveal the former to have a much shorter spire typical of the subgenus *T. (Trochonema)*. Accordingly, the Tasmanian material is assigned to this latter genus.

Family Phanerotrematidae Knight, 1956
Genus *Brachytomaria* Koken, 1925

Type Species: *Pleurotomaria baltica* Deterneuil, 1845; Middle Ordovician; Reval, Estonia

Brachytomaria victoria sp. nov.
Plate 2, Fig. 24 and Plate 3, Figs 1 & 2

Diagnosis: Small form of genus with prominent cord on lower outer whorl surface.

Description: Small to medium turbiniform gastropod with well developed concave selenizone bordered by two distinct cords; whorl profile angular with periphery formed by lower cord bordering selenizone; distinct impressed or abutting sutures; upper whorl surface with variable developed narrow shoulder; profile then either flat or gently convex to upper cord bordering selenizone; below selenizone strongly concave before rounding gently onto base; base rounded without umbilicus; aperture probably sub-circular; columellar lip thick; parietal inductura thin; outer lip from upper suture strongly prosocline to selenizone, shallow lunulae developed in selenizone; below selenizone lip is prosoclyrt to lower cord from which it continues nearly radially with only a slight backward obliquity across the base; regularly spaced collabral lines well developed on upper and lower

outer whorl surfaces; tendency for collabral lines to become foliaceous on upper surface; spiral sculpture composed of single strong variable cord on the lower outer whorl surface.

Dimensions:	Ht	Wt	Wh
UTGD 81789h	10.6	8	6
UTGD 81789g	13.6*	13.3	6+
UTGD 24126	12.8	9.9	6

Distribution: Holotype UTGD 81789h, Paratypes UTGD 81789g and 24126, Smelter's Quarry, Zeehan; Old Flux Quarry, Queenstown.

Material: Type material and three other specimens.

Discussion: Although considerably smaller than the *B. baltica* and possessing a prominent cord on the lower outer whorl surface, the Zeehan form possesses the essential characteristics of the genus. These include the prominent selenizone with bordering threads high on the whorl; short labral slit; turbiniform shape; thickened columellar lip and prominent foliaceous growth lines on outer whorl surface.

Etymology: Named for the Victoria Zeehan Mine, Zeehan.

Nov. gen. et sp.
Plate 3, Figs 3-7

Description: Medium low spired gastropod with distinct concave selenizone located high on the whorl; sutures distinct, abutting; whorl profile changes with growth; in early stages broad nearly horizontal ramp from suture to selenizone; below selenizone gently convexly rounded before turning sharply onto base; in later growth stages, flat to strongly concave surface strongly inclined between upper suture and selenizone; with growth whorl periphery moves from edge of selenizone to lower part of outer whorl surface; narrow base; umbilicus absent; aperture sub-ovoidal; columellar lip short, thick, inclined; parietal inductura lacking; thick outer lip otherwise little known; narrow concave selenizone bordered by two threads; occasionally regularly spaced growth rugae developed; spiral sculpture limited to variably developed basal ridge and cord on upper whorl surface.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 81789h	11.9*	14.8	-	-	5
UTGD 81789p	9.6*	13.0	-	-	3+
UTGD 81789q	8.4	10.4*	-	3.5*	5
UTGD 81789s	7.2	12.8	-	-	5
UTGD 59023	13.9	12.8	-	-	5

Distribution: Smelter's Quarry, Zeehan.

Material: Figured specimen and 12 other specimens.

Discussion: Represented by only a small number of specimens all of poor to indifferent quality, assignment of this form from Zeehan to a family with certainty is not possible. Similarly, the formal establishment of a new genus is not justified based on the material available.

The appearance of the early whorls with the broad nearly horizontal ramp culminating in a distinct peripheral selenizone is suggestive of the genus *Helicotoma*. However, there is no evidence to suggest that a channel is developed or associated with the selenizone at all.

At present the genus is considered a Pleurotomariatoidean. The distinct, relatively narrow concave selenizone bordered by distinct threads would suggest assignment to either the Eotomariidae or the Phancrotrematidae. The latter family is characterised in part by having a well-marked selenizone bordered by sharp threads high on the whorl; labral slit short; anomphalous (Knight et al., 1960). In view of the position and nature of the Zeehan form's selenizone, it is tentatively assigned to Phancrotrematidae. Of the genera composing this family *Brachytomaria* most closely approaches the Zeehan form. However, it can be clearly distinguished by its much higher spired, turbiniform shape and presence of strong distinctive collabral lines and sculpture.

Family Holopeidae Wenz, 1938
Subfamily Holopeinae Wenz, 1938
Genus *Holopea* Hall, 1847

Type Species: *Holopea symmetrica* Hall, 1847; Middle Ordovician; Middleville, New York.

Holopea sp.
Plate 3, Figs 8–9

Description: Small to medium turbiniform gastropod with sculpture composed of variable prosocline growth lines; whorls gently rounded between impressed sutures; periphery at about mid-whorl; base rounded; umbilicus extremely small or lacking; aperture probably sub-circular; no apertural emargination; thickened, gently rounded and reflexed columellar lip; thin parietal inductura present; moderately thick outer lip straight and oblique backwards from upper suture; fine closely spaced growth lines and occasional growth rugae developed; no other sculptural elements.

Dimensions:	Ht	Wt	Wh
UTGD 81789u	18.1	12.8	4+

Distribution: Smelter's Quarry, Zeehan.

Material: four specimens.

Discussion: Comparison between the Zeehan form and *H. symmetrica* is limited by the lack of specimens and poor preservation of the former species. Both are of similar size, shape and possess similar growth lines.

Genus *Threavia* Lamont, 1946

Type Species: *Threavia glosa* Lamont, 1946; Upper Ordovician; Ladyburn, Ayrshire, Scotland.

Threavia maxima sp. nov.
Plate 3, Figs 10–12

Diagnosis: Larger and wider form of genus with more trochiform appearance.

Description: Small turbiniform gastropod with sculpture composed of distinct prosocline growth lines and a single carina low on the outer whorl; whorls gently rounded between abutting sutures; periphery at mid-whorl; base rounded; umbilicus absent, aperture sub-circular; no apertural emargination, thick reflexed columellar lip; parietal inductura developed; moderately thick outer lip straight and oblique backwards from upper suture; fine to rugose variably spaced growth lines; sculpture composed of single prominent carina low on outer whorl.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 81789v	9.3*	12.7	3.1	5.5	4
UTGD 81789x	10.3	10.1	-	-	5
UTGD 81789w	11.5	14.4	3.6	6.5	4+
UTGD 24214	10.9	8.6	-	-	4+

Distribution: Holotype UTGD 81789v, Paratypes UTGD 81789x & w, Smelter's Quarry, Zeehan.

Material: Nine specimens.

Discussion: Lamont's (1946) brief discussion of the type species *T. glosa* is accompanied by only a single illustration making comparison difficult. Both the type species and that from Zeehan are similar in appearance being turbiniform in shape with a globular body whorl and having a distinct carina on the lower outer whorl surface. The Zeehan form is slightly more trochiform in comparison with the type species.

Etymology: Named for the broader shape of the Zeehan form.

Gen. et sp. indet.
Plate 3, Figs 13–14

Description: Medium low spired globular gastropod; whorl profile well rounded; shallow adpressed sutures; base probably rounded possibly with minute umbilicus; aperture probably auriform; thin prosocline outer lip incompletely known; columellar lip slightly thickened, straight and partially reflexed apically; suggestion of thin parietal inductura; fine growth lines and occasional growth rugae developed; no other sculptural.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 57584	21.4	20.5	-	9.9	4

Distribution: Figured specimen UTGD 57584, Smelter's Quarry, Zeehan.

Material: One specimen.

Discussion: The single distorted and, in parts, poorly preserved specimen available prevents any detailed description and useful comparisons being made. Superficially it resembles the coprophagous and variably shaped *Naticonema* but lacks the flat excavated columellar lip of this genus. The poor preservation of the growth lines of the Zeehan form prevents any detailed determination of their irregularity or otherwise. Irregularity of growth lines is a significant diagnostic character of *Naticonema* that relates directly to the mode of life of the genus and its assignment to the Platyceratidae.

The poorly known genus *Umbonellina* from the Ordovician of Estonia also resembles this Zeehan form. Both are globular gastropods having shallow sutures, auriform apertures, and lacking any sculptural elements including growth lines. *Umbonellina* does have a thickened columellar lip and an umbilicus, which is occupied by a small callus and although there is a suggestion of an umbilicus in the Zeehan specimen the preservation is not adequate to determine whether a callus is developed. Inadequate knowledge of both the Zeehan form and *U. infrasibirica* the only known member of the genus means that little can be gained by further comparison or the tentative assignment of the Zeehan form to the genus *Umbonellina*.

Subfamily Gryonematinae Knight, 1956
Genus *Gyronema* Ulrich & Seofield, 1897

Type Species: *Trochonema (Gyronema) pulchellum* Ulrich & Seofield, 1897; Middle Ordovician; Chatfield, Minnesota.

Gyronema sp.
Plate 3, Fig. 15

Description: Medium turbiniform gastropod with sculpture composed of strong spiral cords; whorl profile gently sub-angular; between sutures and cords profile gently concave; sutures channelled; periphery below mid-whorl formed by spiral cords immediately above lower suture; small umbilicus present; aperture ovoidal; no apertural emargination present; columellar lip thick, reflexed; thick parietal inductura developed; moderately thick outer lip straight with slight backward obliquity from upper suture; regular prosocline growth lines; sculpture composed of five spiral cords with the fourth below mid-whorl forming the periphery.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 80899	34.5	28.0	13.0	11.6	6

Distribution: Figured specimen UTGD 80899, 615–640 above sea level, Bubs Hill.

Discussion: The Tasmanian form can be distinguished from *G. pulchellum* by the stronger cord development; fewer cords; channelled sutures; less obliquely inclined outer lip and thicker parietal and outer lips. It is assigned to the genus *Gyronema* rather than either *Loxoplocus* or *Trochonema* because the well preserved aperture of the single specimen lacks the v-shaped sinus of *Loxoplocus* or the development of a channel within a spiral angulation of *Trochonema*.

Family Murchisoniidae Koken, 1896
Genus *Murchisonia* D'Archiac & DeVerneuil, 1841
Subgenus *Hormotoma* Salter, 1859

Type Species: *Murchisonia gracilis* Hall, 1847; Middle Ordovician; Watertown, New York.

Murchisonia (Hormotoma) sp.
Plate 3, Figs 16–17

Description: Medium, high spired gastropod with selenizone between two cords at rounded whorl periphery; sutures distinct, of moderate depth; whorl profile rounded; base rounded; umbilicus absent; columellar lip thin, arcuate; aperture poorly known; from upper suture prosoeyrt growth lines pass strongly backward to selenizone; below selenizone prosoeyrt lines pass strongly forwards to base; growth lines fine, closely spaced; occasional stronger lines developed; apart from cords bordering selenizone no spiral sculptural elements developed.

Dimensions:	Ht	Wh	Hap	Wap	Wh
UTGD 90864a	12.1	4.4*	2	-	8
UTGD 90864b	12.6*	6.4	-	-	4+

Distribution: Figured specimen UTGD 90864a and UTGD 90864b, Smelter's Quarry, Zeehan; Old Flux Quarry, Queenstown.

Material: Figured specimen and three other specimens.

Discussion: Comparison between the Zeehan form and *M. (H.) gracilis* is limited by the lack of material from Zeehan and the poor preservation of the type species. The Tasmanian form appears quite similar to the type species and cannot be readily distinguished on any of the features currently known. Similar sized poorly preserved forms are also known from the Old Flux Quarry, Queenstown.

Family Clisospiridae Miller, 1889
 Subfamily Clisospirinae Miller, 1889
 Genus *Clisospira* Billings, 1865

Type Species: *Clisospira curiosa* Billings, 1865; Early Ordovician; Quebec, Canada.

Clisospira sp.
 Plate 1, Figs 20–21

Description: Small, sinistrally coiled trochiform gastropod with narrow prominent frill; whorl profile concave from narrow shoulder to thickened narrow peripheral frill; umbilical surface unknown; aperture unknown; sculpture composed of strong prosocline growth lines which continue onto the thickened frill edge, and at times have a tendency to be irregularly spaced. No evidence of spiral sculptural elements.

Dimensions:	Ht	Wt	Wh
GST 1130d	?	?	5
GST 1130e	?	?	3

Distribution: Figured specimen GST 1130d and GST 1130c, Huskisson River.

Material: Figured specimen and one other specimen.

ACKNOWLEDGEMENTS

The support and encouragement of Dr Maxwell Banks in this project including the review of an early draft of the paper and the helpful suggestions is greatly acknowledged.

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Table 1. Distribution of Upper Ordovician Gastropods from New South Wales and North America.

	1	2	3	4
<i>Tropidodiscus</i>	*	*	*	*
? <i>Bucania</i>				*
? <i>Tetranota</i>				*
<i>Raphistoma</i>	*		*	*
<i>Liospira</i>	*	*	*	*
<i>Paraliospira</i>	*	*	*	*
Helicotomidae Nov. gen. et sp.				
<i>Lesuerilla</i>		*		*
<i>Eotomaria</i>		*		*
<i>Lophospira</i>	*	*	*	*
<i>Donaldiella</i>				*
<i>Trochonema</i>	*	*	*	*
<i>Brachytomaria victoria</i>				*
Phanerotrematidae Nov. gen et sp.				
<i>Holopea</i>	*	*		*
<i>Threavia</i>				*
Holopeinae gen. et sp. indet.				
<i>Gyronema</i>		*	*	*
<i>Murchisonia (Hormotoma)</i>		*	*	*
<i>Clisospira</i>				*

1. New South Wales
2. Klamath Mountains, California
3. Seward Ranges, Alaska
4. Laurentian platform and margin

Table 2. Distribution of Upper Ordovician Gastropods from Western Tasmania.

	1	2	3	4	5	6	7
<i>Tropidodiscus huskissoni</i>	*						
<i>Tropidodiscus</i> sp.			*	*			
? <i>Bucania</i> sp.				*			
? <i>Tetranota</i> sp.			*			*	
<i>Raphistoma montanum</i>			*		?*		
? <i>Raphistoma</i> sp.			*			*	
<i>Liospira regina</i>			*			*	
<i>Paraliospira insula</i>			*	*		*	
Helicotomidae Nov. gen. et sp.			*				
<i>Lesuerilla johnstoni</i>			*				*
<i>Eotomaria</i> sp.			*				
<i>Lophospira corona</i>			*			*	
<i>Lophospira florensis</i>			*				
<i>Lophospira argenta</i>			*		?*	*	
<i>Lophospira salteri</i>							?*
<i>Donaldiella brittania</i>			*				
<i>Trochonema (T) etheridgei</i>				*			
<i>Trochonema (T) montomerii</i>		*	*				*
<i>Brachytomaria victoria</i>			*		*		
Phanerotrematidae Nov. gen et sp.			*				
<i>Holopea</i> sp.			*				
<i>Threavia maxima</i>			*				
Holopeinae Gen. et sp. indet.			*				
<i>Gyronema</i> sp.			*				
<i>Murchisonia (Hormotoma)</i> sp.			*		*		
<i>Clisospira</i> sp.	*						

1. Huskisson River
2. Despatch Limestone, Zeehan
3. Smelters Quarry / Austral Valley, Zeehan
4. Austral Valley, Zeehan
5. Old Flux Quarry, Queenstown
6. Bubs Hill
7. Gordon River